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<p>(21) International Application Number: PCT/SE95/00746</p> <p>(22) International Filing Date: 16 June 1995 (16.06.95)</p> <p>(30) Priority Data: 9402151-6 17 June 1994 (17.06.94) SE</p> <p>(71) Applicant (for all designated States except US): GRÄSCENTER I ESKILSTUNA AB [SE/SE]; 753A Kolunda, S-635 19 Eskilstuna (SE).</p> <p>(72) Inventor; and</p> <p>(75) Inventor/Applicant (for US only): ROSÉN, Kjell [SE/SE]; 753A Kolunda, S-635 19 Eskilstuna (SE).</p> <p>(74) Agents: BROLIN, Tommy et al.; Brolin &amp; Sedvall Patentbyrå AB, P.O. Box 7182, S-103 88 Stockholm (SE).</p>		<p>(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).</p> <p><b>Published</b> <i>With international search report.</i></p>	
<p>(54) Title: A PRODUCTION METHOD FOR LAWN SOD ROLLS AND A DEVICE TO PERFORM THE METHOD</p> <p>(57) Abstract</p> <p>A method and device for sod rolls, the cut-out pieces of a lawn being harvested and transported (32) to a stacking station to stack the sod rolls in layers or in beds. The stacking is performed with the rolls of adjacent layers rotated about a quarter of a turn in relation to each other, the rolls in each second layer by means of rotation devices (40, 42) then being rotated about 90 degrees during their transport from the rolling station to the stacking station.</p>			

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A Production Method for Lawn Sod Rolls and a Device to  
perform the Method

The present invention relates to a device to harvest sod pieces to be formed to rolls and thereafter to be stacked for storage and further transportation to an application area.

When harvesting lawn sod rolls, here below even called sod rolls, machines are used nowadays comprising cutting and pick-up devices to cut and to pick up pieces of a lawn, transportation devices to form the sod rolls out of these pieces and to transport these to stacking devices to assemble and stack the sod rolls in a storage area. To achieve a steady stacking of the sod rolls not to fall down the rolls in each layer must be turned about a quarter of a turn or in 90 degrees relative to the rolls of the adjacent layers. i.e. the above and the beneath situated layers.

Previously sod roll harvesting machines were used, where the driver was sitting on top of the pick-up unit and a collaborator was placed at the transport and stacking device taking care of the rolls and stacking these in the previously said way.

To facilitate the roll stacking operation and to achieve a machine to possibly be operated by only one operator it is from the swedish patent 9002919-0 already known to stack the rolls in a closed storeroom to be turned 90 degrees for each layer or bed with rolls to be stacked in a transverse direction with respect to the adjacent layers. i.e. the above and the beneath situated layers. In this way only one operator can operate the machine and simultaneously survey the roll transportation to the storeroom and the stacking of the rolls therein. During the deposition of a complete stack of rolls one side of the storeroom is opened and the stack, mostly placed on a pallet, is put to the ground, after that the

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upper roll layer is fixed by means of a loose frame with hooks. After that the upper stack part is covered with plastics the frame can be removed and the roll stack is ready for storage or for transportation.

According to the present invention another way may be chosen to solve the stacking problem of the completed rolls.

The main purpose of the invention is thus to achieve a simplified stacking device providing the use of a generally open storeroom not to be turned, the roll stack then removed from the machine without any help from the operator.

Another purpose is to achieve a stacking device, the plastic covering of the upper layer there provided automatically after completing the stack.

Another purpose is to achieve a sod pick-up machine with a suitable design with respect to its operation and to be easily controlled and operated by one operator with a sufficient survey over the whole pick-up and stacking process.

These and other purposes and advantages of the invention are achieved by providing the device with the characteristics specified in the attached claims.

A preferred embodiment of the invention will be described more in detail in connection with the drawings. And thus

Figure 1 shows a side view of a sod pick-up machine according to the invention,

Figure 2 shows a plane view of the machine in figure 1,  
Figure 3 shows a partial top view of the transverse transportation and rotating device for the sod rolls of the machine,

Figure 4 shows a side view of a detail of a bucket for the sod rolls,

Figure 5 shows a plane view of the device in figure 4,

Figure 6 shows a side view of a detail of a rake to push the sod rolls into the storeroom,

Figure 7 shows a plane view of the device in figure 6,

Figure 8 shows a side view of a detail of a sensing device in the stacking area of the machine,

Figure 9 shows a perspective view of a plastic packaging device for the sod rolls in the machine,

Figure 10 shows a partially cut side view of the device in figure 9, and

Figure 11 shows a side view of a detail of the plastic packaging device.

In the shown embodiment the lawn pick-up machine comprises a machine frame or a frame work 10 carrying the appertaining stations or units. The frame work 10, on one side equipped with driving wheels 12 mounted in bearings on the lower machine portion, is rigidly connected to a front driving unit 14. This driving unit illustrated with dotted lines comprises in the shown embodiment an ordinary tractor with a driving motor 16 and front wheels 18. The rear axle of the tractor 14 is rigidly fastened to the frame 10 and its back driving wheels are removed and replaced by gears 20, which by means of chains, driving belts 24 or similar are connected with corresponding gears 26 on the driving wheels 12. In that way the lawn pick-up machine of the invention can be linked to an already existing tractor, thereby substantially reducing the costs for the complete machine. The frame work 10 can of course be lengthened at the front and in itself comprise forward wheels and driving units without leaving the scope of the invention. The frame work 10 has a platform 28 forming the driver seat at the back. To enable the operators action the steering and all other controls (not shown) for the driving of the machine are lifted up onto the platform 28 by means of any known technology, such as a hydraulic transmission, electric connections or similar. With the driver seat arranged at the back on the frame work 10 the operator has a complete survey over the driving unit in front

of him and can easily drive and control the machine and its performance from the platform 28. Even the units for pick-up, transportation, rolling, rotation and stacking of the sod pieces and the sod rolls, respectively, are situated in front of the operator and he thereby can survey these functions of the machine and adjust and stop the complete sod roll treating process, respectively, if this due to any bad performance of the units should be necessary.

By means of a side frame 30 the frame work 10 supports a lawn cutting and pick-up unit 32, which in an already known way comprises a cutting head 34 (fig 2) with a vibrating cutter loosening the lawn in the longitudinal direction of the unit and a cropper deviding the cutted lawn into convenient lengths to form the desired sod rolls. The unit 34 comprises also rolls and/or bristles to trim the lawn before pick-up and also register wheels to achieve equally long pieces and thereby equally large sod rolls. The components comprised in the unit 34 are already known and are therefore not illustrated or described here.

The conveyor 32 transports the loosened lawn pieces up to a rolling device comprising a conveyor belt cooperating with the conveyor and running in opposite direction, arranged above the conveyor 32 at its upper end. Such a rolling unit is illustrated and described in the previously mentioned swedish patent, being here referred to, and is therefore not shown in any further detail. Other kinds of units can of course be used within the scope of the invention to form the rolls of the separated pieces. At the upper end of the conveyor 32 a belt conveyor 36 is arranged tranverse with respect to the machine driving direction, on which conveyor the completed sod rolls 38 are transported to the stacking and storing station. At the end of the conveyor 36 near the stacking station a rotation device is placed to turn the rolls one quarter of a turn before they reach the feeding unit of the stacking device. The rotation makes the sod rolls of every second

layer to be placed transverse to the rolls in the adjacent layers and thereby locking the sod rolls in the above and beneath placed layer or bed. The rotation device comprises a lever 40 with a crook 42, the lever being supported in a bearing 44 and by means of a spring 46 pushed to a position, in which the lever is hitting a stop 48 with its crook engaging the end surface of the sod roll 38 and against the spring force can be pushed to another position with the crook situated outside the sod roll passage, and in which second position the lever can be locked by means of a solenoid piston 50 or a similar control device. When the lever 40 is in the active position in contact with the stop 48 and a roll with its end hits the crook 42, the roll will by means of the feeding force of the conveyor 36 be turned a quarter of a turn, as indicated by the sod roll designed in dotted lines, the lever 40 with the crook 42 holding the roll end against the spring force 46. The lever 40 returns, when the sod roll 38 has been transported further off according to the description here below to a position, where the lever is in contact with the stop 48 to catch next sod roll 38 to be rotated. When putting down a layer of sod rolls not to be rotated, the lever 40 is situated in the position shown with dotted lines, in which position the lever is locked by means of the locking solenoid 50.

With the roll 38 just been turned to the position shown with dotted lines in figure 3, it is pushed off on a feeding mat 52 by means of a rake 54 which by means of a lever 56 is supported in a rack on top of the conveyor belt 36 and is controlled by means of a hydraulic cylinder. The lever 56 of the rake 54 is coupled in such a way that the rake 54 rigidly moves the roll 38 to a desired position on the mat 52, i.e. so that the roll is pushed onto the mat and is freed from the crook 42, the next roll then possibly to be rotated in the previously mentioned way. The following movement of the roll to the mat end is provided by that the next sod rolls are pushing from

behind by means of the rake, which then not has to move along the whole length of the mat 52. When returning to the original position at the end of the conveyor 36 the rake 54 is bending and passes the upper side of the next roll 38. The movement of the roll 38 over the mat 52 by means of the rake 54 is performed against a bucker 60 (fig 4 and fig 5) consisting of a shaft 57 and a thrust plate 59 and bending under the load of the rake 54. Thus, the roll 38 will face upwards, its longitudinal axis becoming perpendicular to the longitudinal axis of the rollers 38 longitudinal shaft situated on the conveyor 36. The bucker 60 guided in a guide 67 is under pressure by means of a load 61 which by means of a cord 63 conducted over cord wheels 65 provides the necessary resistance against any movement of the sod rolls 38 across the mat 52.

Obviously the purpose of the rotation device is to turn the rolls 38 in every second layer before they are stacked in the storeroom, implying the rolls 38 in the other layers or beds not to be turned, the lever 40, as mentioned, lying in an inactive position there being locked by means of the solenoid 50. The further transportation over the mat 52 of the rolls not been turned is performed in the same way by the rake 54 in the previously described manner.

It is obvious that the shown rotation device can be achieved in other ways than that shown here, even if this one is preferred due to its quick operation. Thus it is possible to arrange a rotary disc at the end of the conveyor 36, on which the sod roll 38 is ejected and which together with the sod roll is rotated a quarter of a turn by means of a control device such as a rotary motor.

In the shown embodiment each layer or bed of rolls is stacked on a fork lift 62 with forks 64 which as usually runs vertically in the lift 63 by means of a hydraulic cylinder or chain transmissions (not shown) or similar. The layers consist in the illustrated example of generally four sided or rectangular layers or beds, in which the

rolls 38 in the on the lift forks 64 shown layer in figure 1 are arranged five laterally in the driving direction of the machine, while three rolls 38 are situated in line next to each other in the transverse direction of the machine. The rolls of this layer thus have not be turned in the rotation station, whereas the rolls 38 of the following layer shall be rotated a quarter of a turn in relation to the shown layer. Independent of if the rolls 38 are turned or not and thus are lying three in line and five side by side on the mat 52 the output of the rolls from the mat 52 to an on top of the forks 64 placed roll front bottom 66 is achieved by means of a rake 68 guided in a guiding frame 69 on top of the fork lift 62, 64 and reciprocating in the arrow direction in figure 7 by means of a hydraulic cylinder 71. To return the rake 68 after feeding a row of sod rolls onto the bottom 66 to the original position shown in figure 2 on the mat 52 it has to be lifted over the bucket 60, effected by means of a on a rack 72 the fastened hydraulic cylinder 70 lifting and lowering the rake 68 as shown with an arrow in figure 6. The bottom 66 is placed within a on top of the frame work arranged box or storeroom 76 which is open to the rake 68 and open downwards under the bottom 66 to let a layer rolls 38 fall down from the bottom 66 onto the fork lift 62, 64. The bottom 66 is as already said for example of a roll front type and consists of two halves to be opened from the centre of the bottom 66 and be pulled away to two opposite sides to let the layer rolls 38 built up on the bottom 66 fall down as previously described. Such a bottom is described in the previously mentioned swedish patent 9002919-0 here referred to for further details of the bottom 66. On the forks 64 of the lift a pallet can be arranged or some other bedding to carry the layers of rolls, or else like in the shown example the rolls 38 of the lowest layer can be directly supported by the forks. In this case the fork lift has a special design and comprises a multitude of forks 64, e.g. six forks. As not every sod

roll has the same diameter the lowering of the fork lift 62, 64 is according to figure 8 controlled by means of a sensor in contact with the upper side of the sod roll layer, registering the sod roll passage to a position with empty place for the next layer or bed of sod rolls 38 directly beneath the bottom 66 and then stops the lowering of the fork lift 62, 64.

When a sufficiently large number of layers is stacked on the fork lift 62, 64, usually six layers vertically, the thus formed stack of sod rolls can easily be put down on the ground by lowering the fork lift to the ground while the machine proceeds ahead the stack of rolls exiting through a corresponding opening in the aft part 74 of the machine frame 10. Before the completed stack leaves the machine its upper layer must be anchored not to let the stack fall down or disintegrate. This is e.g. performed by winding a plastic foil, a net a tissue or similar around the upper stack layer. The machine having a generally open storeroom 76 this is automatically achieved without the operator possibly leaving the machine and performing the anchoring by hand. The storeroom consists as previously mentioned in the shown execution example of a box 76 situated on top of the frame work, and thereby providing that the upper layer of sod rolls 38 in a stack are partly uncovered as shown in figure 1. Around the box a guide 82 is running suspended by means of props 80 in a frame 78 here shown in a perspective view and in cross section in figures 9 and 10, respectively. A carriage comprising a plate runs on the guide 82 with four wheels equipped with a central groove, with which the wheels engage the edges of the guide 82. A transmission consisting of a chain, a cord 88 or similar is arranged for driving the carriage around the guide and also sprockets or cord wheels 90, of which at least one is a driving one. On the carriage underside a socket is fastened articulately for a roll 92 of plastic foil, tissue or similar, the socket comprising a shaft 94 and a bottom plate 96. From the roll

92 the plastic foil is passing a stretching device before it is wound up around the stack of sod rolls 38. The stretching device comprises two rolls or rollers 98, over which the foil or similar will pass. A socket 100 is fastened to the machine frame 30 for a pivotably supported lever 102 being pivotable by means of a hydraulic cylinder 104 between the positions shown with continuous and with dotted lines. When starting the plastic covering of the stack the lever 102 has attached the end 106 of the plastic foil against a roll 108 placed on one end of a lever 110, the other end of which is loaded by a spring 112. The end of the plastic foil being thus fixed the roll 92 is passed around the guide 82 and covers the upper part of the sod roll stack still remaining in the machine on the fork lift 62, 64 with plastic. After a passage of e.g. 3-4 times of the carriage with the roll 92 around the stack the lever 102 is lifted up to the vertical position shown with dotted lines to free the foil end, i.e. the start end, locked by the lever 102 in its lowered position. When the carriage with the roll 92 passes next time the foil is placed on the outside of the lever 102 when lowered will drag the foil down to a locked position. The lever 102 is lowered further the foil roll having stopped, while the roll 108 stands aside due to the spring load 112 the foil thereby coming in contact with a knife 114 and is cut off, the final end of the plastic covering foil is freed and can pivot upwards and be attached to the plastic wound around the sod roll stack. The lever 102 holds simultaneously back the start end 106 of the foil to be used to cover the next stack or sod roll package 38 with plastic.

According to the invention a sod harvesting machine has been achieved and a method to harvest sod rolls and to store these, with which machine a single operator or driver can perform the process from the harvesting to the storing of complete packages of sod rolls without any manual operation being necessary, i.e. without the operator leaving his seat on the platform 28.

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The invention is of course not limited to the shown and described embodiment and can be varied within the scope of the invention.

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C L A I M S

1. A production method for sod rolls, the cut-out pieces of a lawn being harvested and transported to a rolling station, in which the harvested pieces are rolled to sod rolls, the sod rolls thereafter being transported to a stacking station to stack the sod rolls in layers or in beds, characterized in that the stacking is performed with the rolls of adjacent layers rotated about a quarter of a turn in relation to each other, the rolls in each second layer then rotated about 90 degrees during their transport from the rolling station to the stacking station.

2. A method according to claim 1, characterized in that the sod rolls of each second layer are rotated a quarter of a turn with one end of the roll being engaged and held, whereas the the roll is transported on and the holding finishes when the roll has rotated a quarter of a turn.

3. A device to perform the method according to anyone of the claims 1 or 2, comprising cutting and harvesting devices (32) to cut and harvest pieces of lawn, transportation devices to form sod rolls from said pieces and to transport these to stacking devices to compose and stack the sod rolls in beds or layers, the stacking being performed with the rolls rotated about a quarter of a turn in relation to each other, characterized in rotation devices (40, 42) adapted to rotate each sod roll of every second layer so that the sod rolls in that layer will have their longitudinal axis perpendicular to the sod roll axes of the adjacent layer, i.e. the layers above and below.

4. A device according to claim 3, characterized in that the rotation devices comprise with the transportation device cooperating gripping devices (40, 42) adapted to

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engage the end of each sod roll of the layer, where the rolls will be rotated and to hold said end so that the sod rolls (38) are rotated on the transportation device during transportation of the sod rolls, the gripping devices being adapted to free the sod roll rotated a quarter of a turn.

5. A device according to claim 3, characterized in that the rotation device comprises a rotary disc or similar rotating each sod roll of the layer to be rotated during the transport of the sod rolls to the stacking devices.

6. A device according to claim 4, characterized in that the gripping devices consist of a lever (40) with a crook (42), the lever (40) supported in a bearing (44) and pushed by means of a spring (48) to a position, where the lever hits a bumper (48) and in which position the crook (42) can engage a sod roll passing on the transportation device (36).

7. A device according to claim 6, characterized in that the lever (40) can be pushed against the pressure from the spring (46) to a position, where the crook (42) is positioned outside of the sod roll passage, in which position the lever (40) can be locked by means of an operating device (50).

8. A device according to any of the claims 3-7, characterized in that the stacking devices comprise a storeroom (76) with a boxlike frame (76) with a retractable bottom (66) at the top to achieve a layer of sod rolls, the frame below said bottom surrounding the upper layer of the sod roll stack (38) and a below the storeroom placed fork lift (62), on which the layers of sod rolls are stacked directly or by means of a mat.

9. A device according to claim 8, characterized in that the lowering of the fork lift (62) during the stacking of the sod rolls is controlled by a sensor (73) arranged in the storeroom, registering the sod roll passage

downwards to a position leaving room for the next layer of sod rolls beneath the storeroom bottom (66) and thereby stopping the lowering of the forks (64) of the fork lift (62).

10. A device according to any of the claims 3-9, characterized in that it comprises wrapping devices arranged adjacent to the stacking devices to cover the upper layers of the stack of sod rolls with a cover of plastic foil, tissue, net or similar, the wrapping devices comprising a guide (82) arranged around the upper part of the stacking devices and a carriage (84, 86) running around said guide, supporting a roll (92) with wrapping material to be wrapped around the stack of sod rolls.

11. A device according to claim 10, characterized in a stretching device (98) adjacent to the roll (92) of wrapping material to stretch it during winding.

12. A device according to claim 10 or 11, characterized in a pivotably supported lever (102) arranged to be lowered from a position, in which it lies inside the guide and thus inside the wrapping material and thereby can catch at least one turn of said material, to a position, where it pushes said winding turn to engage a knife (114) for cutting the wrapping material and form an end of said material, the lever (102) in lastmentioned position even retaining the wrapping material to form a start end for the next winding.

13. A sod harvesting machine to produce sod rolls, the cut-out pieces of lawn being harvested and transported to a rolling station, where the pick-up pieces are rolled to sod rolls, whereafter the sod rolls are transported to a stacking station to stack the sod rolls in layers or in beds, comprising a driving unit (14) with steerable wheels (18), a frame work (10) attached to the driving unit with driving wheels (12) and carrying cutting and harvesting devices (32) to cut and harvest pieces of lawn, forming devices to form sod rolls (38) from these pieces and

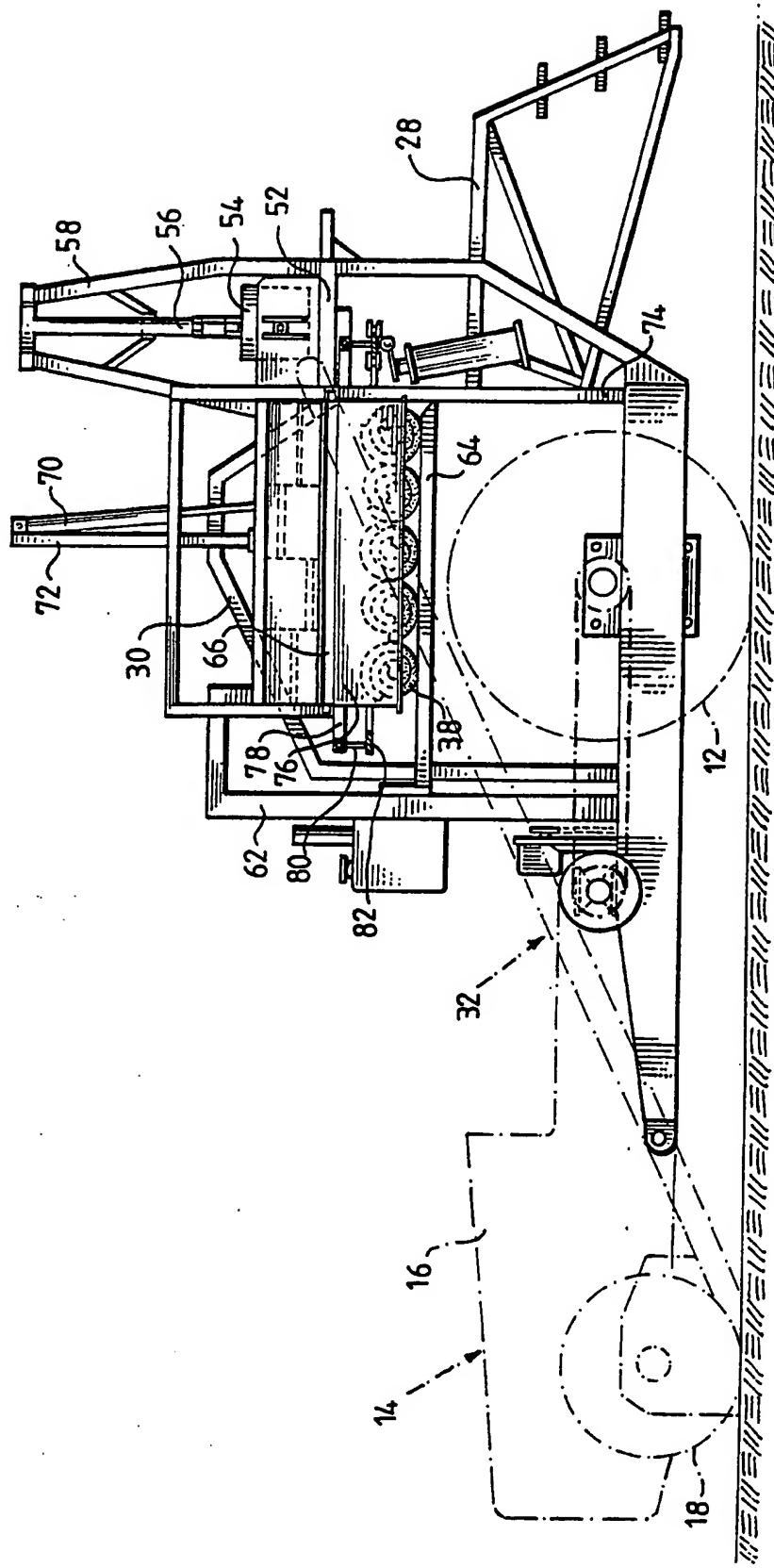
transportation and stacking devices to assemble and stack the sod rolls in layers or beds, characterized in a platform (28) arranged at the back seen in the driving direction of the machine on the frame work (10) behind said unit and devices, the platform providing the driver seat, at which all controls for driving and control of the machine and for the operation of said devices are concentrated to be operated by only one operator surveying all functions of the machine.

14. A sod harvesting machine according to claim 13, characterized in that the driving unit (14) with the steerable wheels (18) is stiffly connected to the frame work (10).

15. A sod harvesting machine according to claim 13 or 14, characterized in that the driving unit (14) with the steerable wheels (18) comprises a standard type tractor with driving wheels (12) transferred to the frame work (10) and via transmissions driven by the tractor rear axle.

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Fig. 1



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Fig. 2

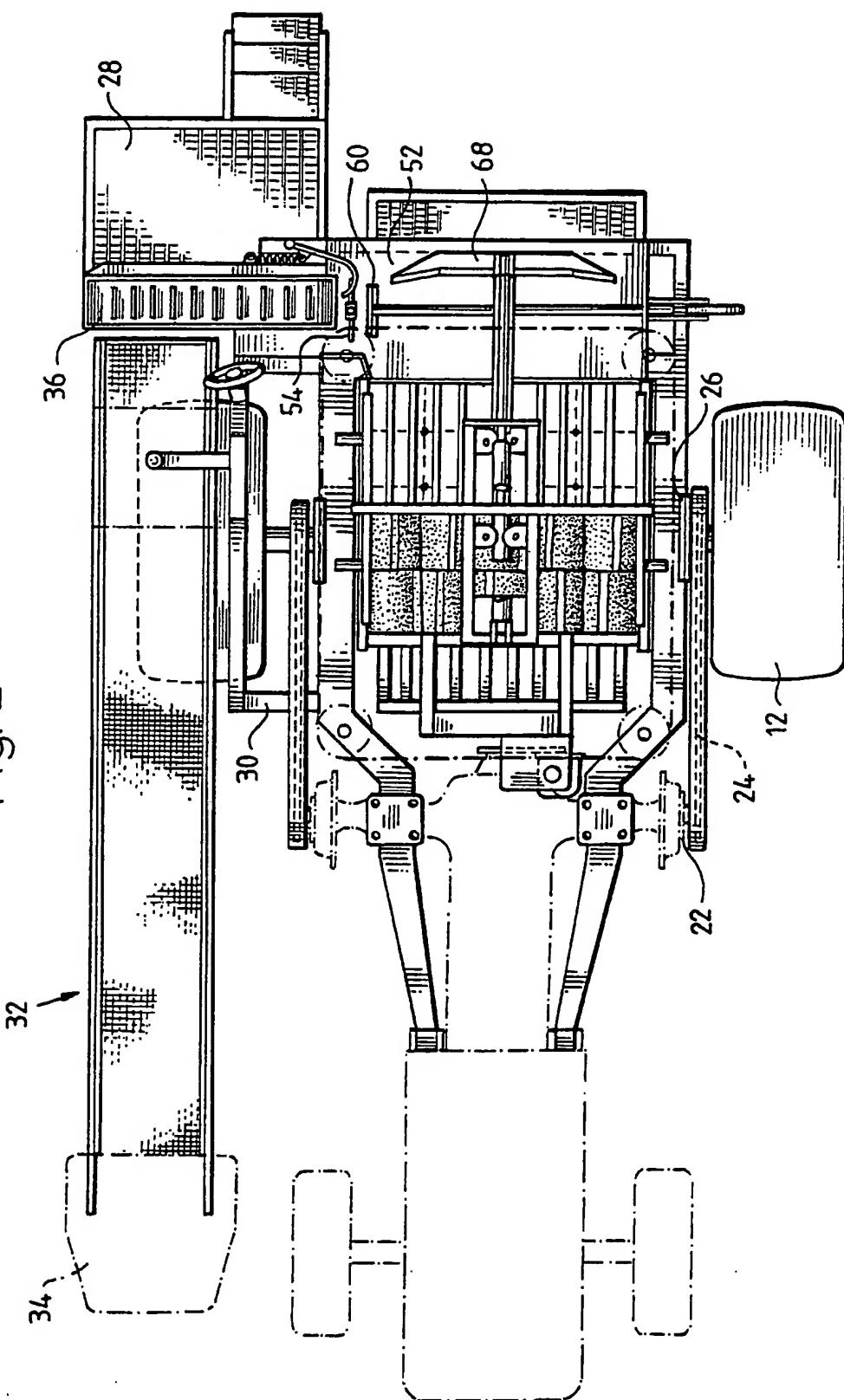
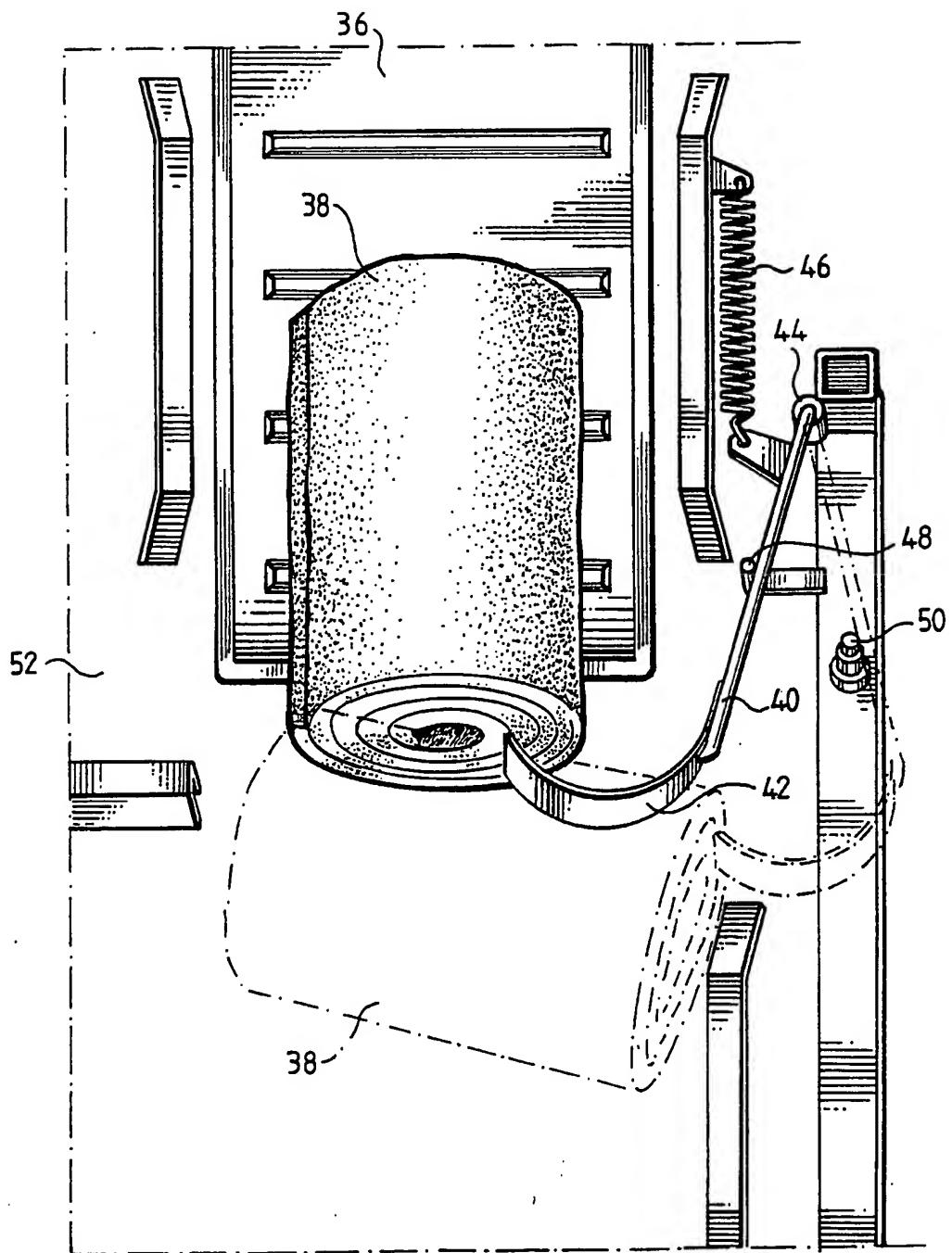


Fig. 3



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Fig. 4

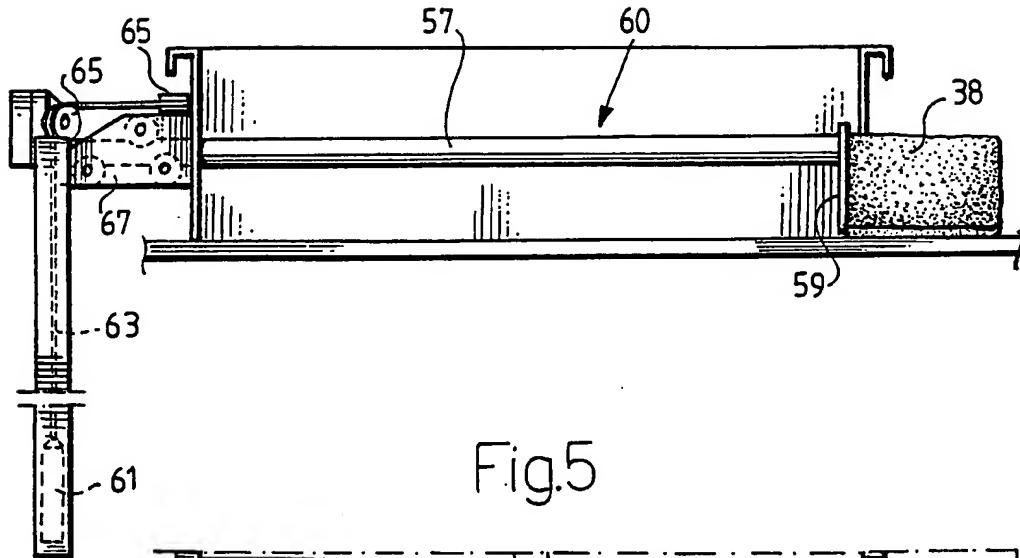


Fig. 5

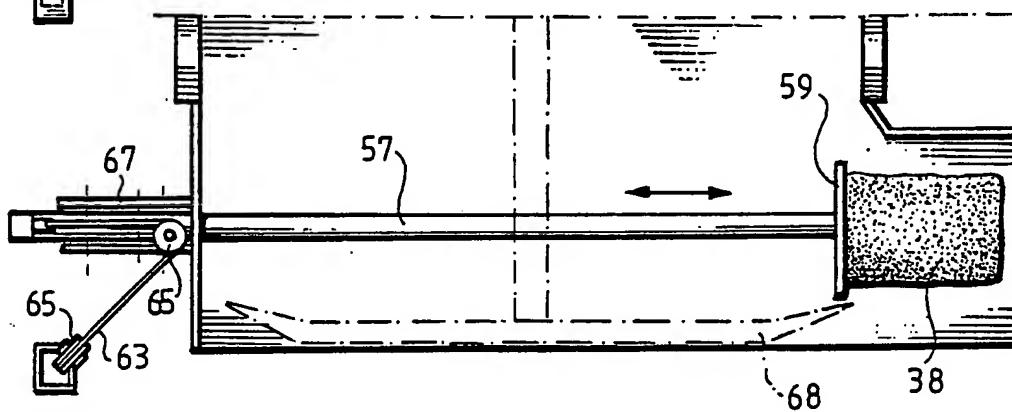


Fig. 6

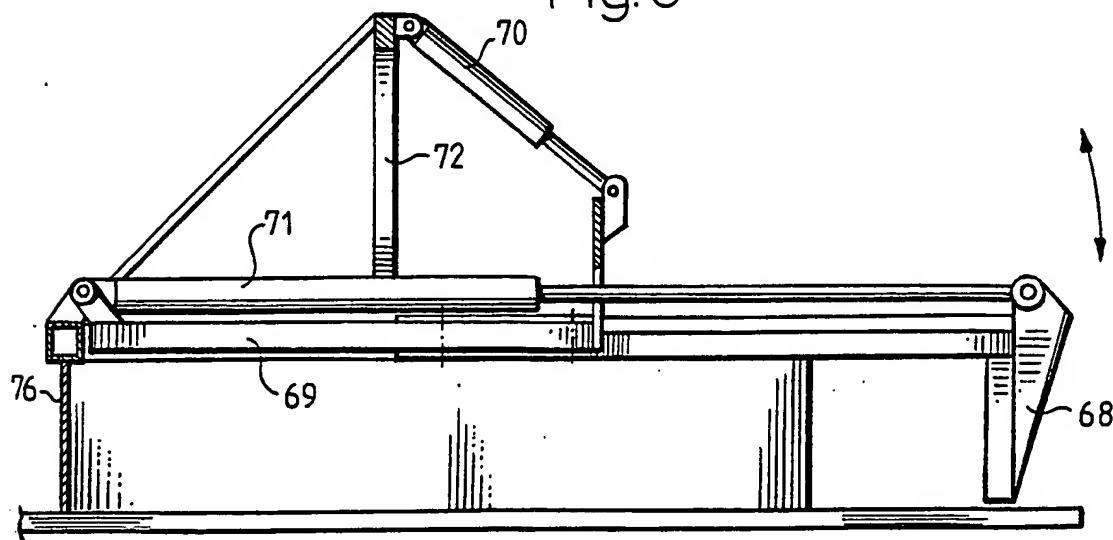


Fig. 7

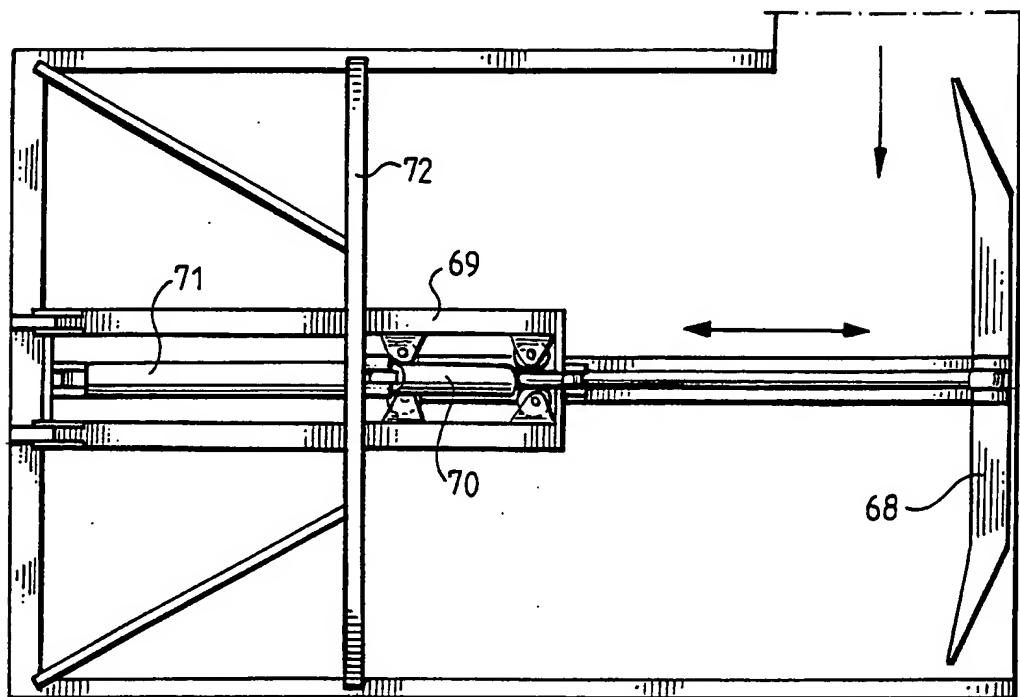
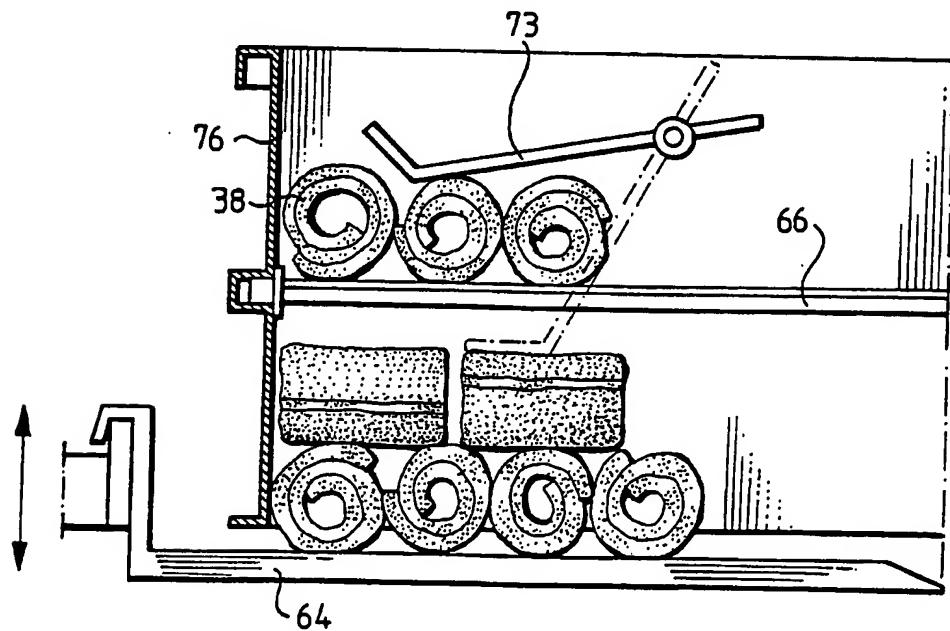


Fig. 8



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Fig.9

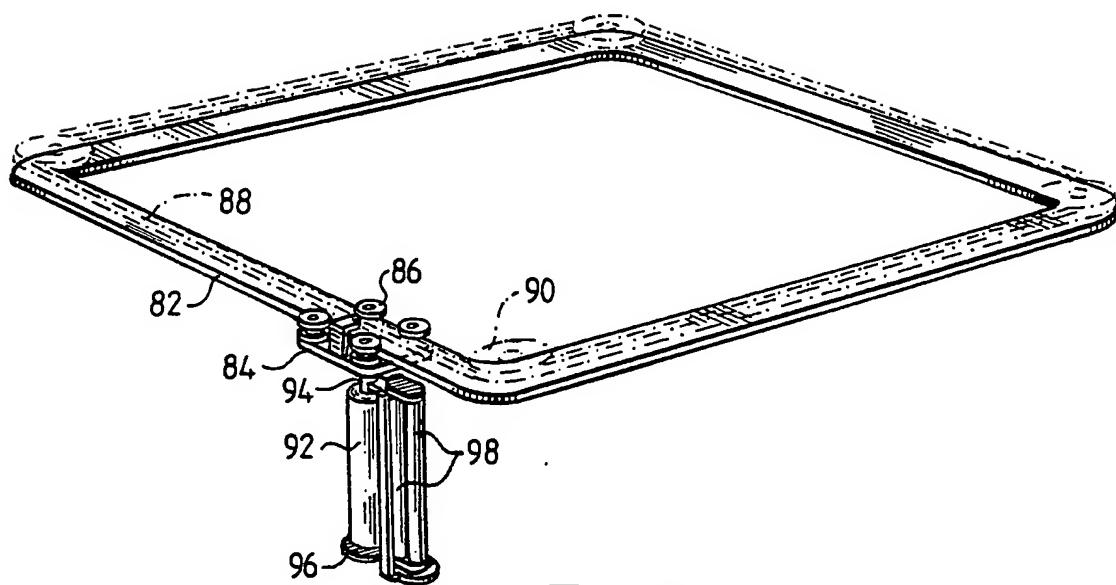


Fig.10

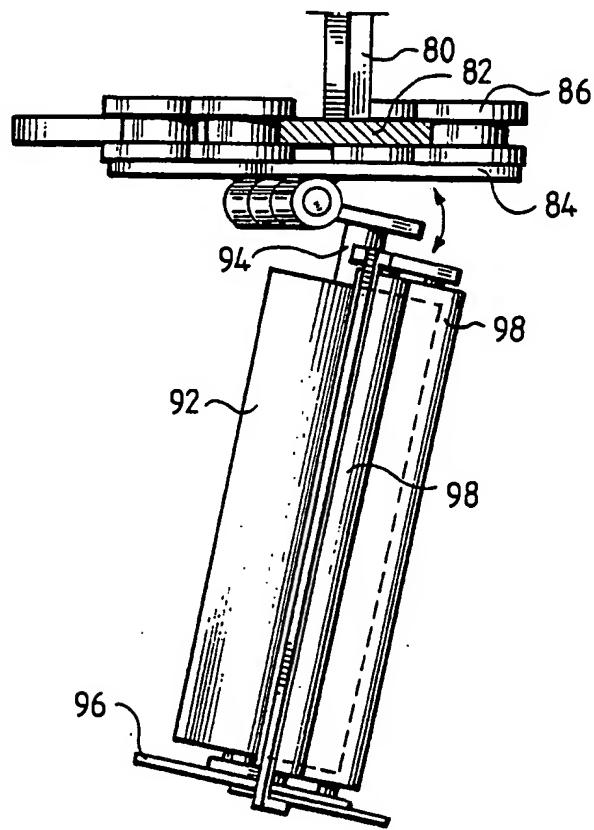
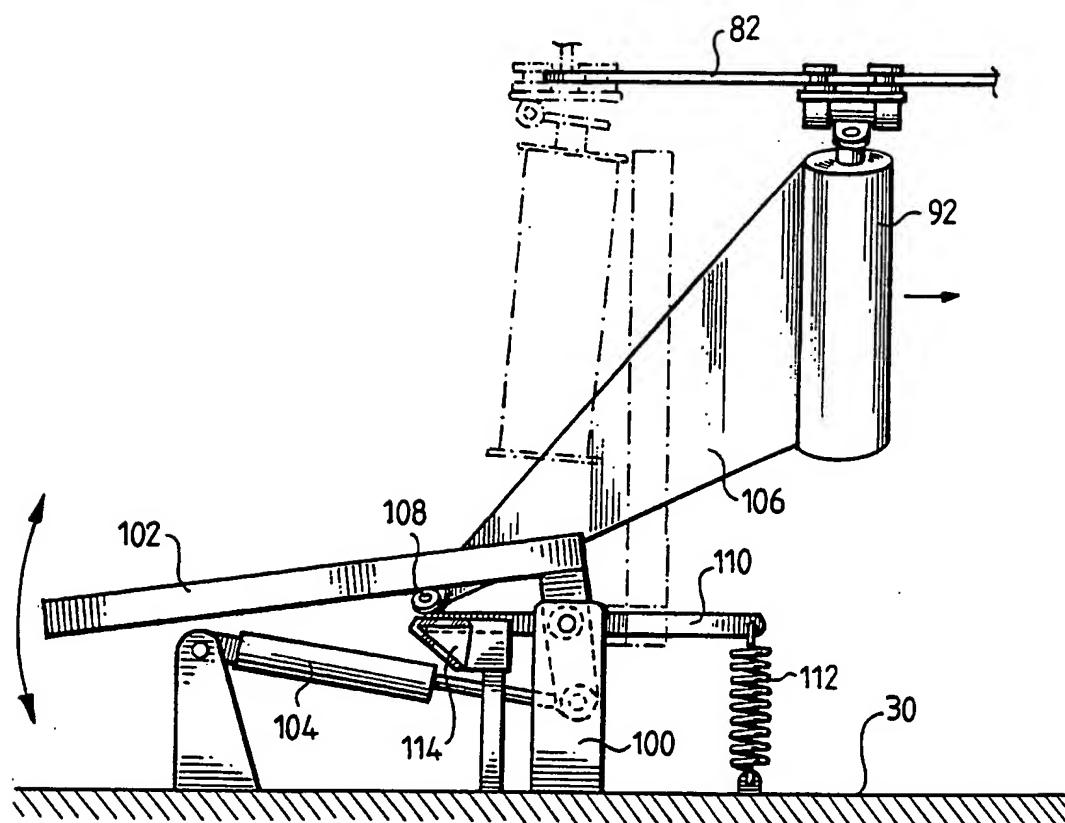


Fig. 11



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 95/00746

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A01B 45/04 // B65G 57/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A01B, B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim №
X	US 5269379 A (MILLAR ET AL), 14 December 1993 (14.12.93) --	1,3,5
X	EP 0581607 A1 (CABER MOR HOLDINGS LIMITED), 2 February 1994 (02.02.94) --	1
X	SE 467603 B (GRÄSCENTER I ESKILSTUNA AB), 17 August 1992 (17.08.92) --	1
A	EP 0243779 A1 (GABARD, RAYMOND), 4 November 1987 (04.11.87) --	1

 Further documents are listed in the continuation of Box C. See patent family annex.

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International application No.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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**INTERNATIONAL SEARCH REPORT**  
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